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U.S. COMMAND AND GENERAL STAFF
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AIR EVACUATION AND ITS EFFECT
ON THEATER AND ZONE OF INTERIOR
HOSPITALIZATION REQUIREMENTS

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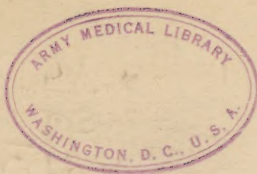
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ANALYTICAL STUDY

SUBJECT NO. 3-2

SUBJECT: Air evacuation and its effect on theater and zone of interior hospitalization requirements.

1. Problem.—To compare the use of air evacuation and the use of surface means of evacuation to develop the most efficient evacuation policy and means of evacuating casualties.
2. Discussion.
 - a. Air evacuation provides the only practical means of implementing a shorter evacuation policy. (See Annex 1, par 3)
 - b. The advantages obtained by utilization of air evacuation in conjunction with a shorter evacuation policy are:
 - (1) Provides a substantial savings in medical manpower and skilled specialists. (See Annex 1, par 5)
 - (2) Provides a substantial savings in construction effort and construction materials in the theater of operations. (See Annex 1, par 3)
 - (3) Provides better medical treatment and improves troop morale. (See Annex 1, par 6)
 - (4) Reduces fixed bed requirements in theater of operations. (See Annex 1, Par 6)
 - (5) Provides for better use of equipment and at the same time reduces the load that surface evacuation normally places upon surface lines of communication. (See Annex 2)
 - c. The only disadvantage resulting from the utilization of air evacuation in conjunction with a shorter evacuation policy is that theater replacement requirements will be increased. (See Annex 1, par 7)
 - d. Aircraft used in air evacuation are adequate for all echelons except that performed within the combat zone. (See Annex 1, par 8)

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Annex 1. Hospitalization and Evacuation.

1. General. The primary purpose of any study of the effect of air evacuation on the evacuation policy and the hospitalization requirements is to determine the policies and procedures which would be most advantageous to the armed forces in the event of another global war. Future warfare will undoubtedly differ from past wars, however, a study of some of the medical aspects of past wars provides the only logical approach to the development of sound policies and procedures for the conduct of the medical service in future warfare. The following paragraphs review some of the definitions used in connection with medical service and attempt to analyze the pertinent features of the evacuation and hospitalization service.

a. Definition. "Air Evacuation" as employed herein is used to designate the service provided the sick and wounded in transporting them by military aircraft to hospitals where medical treatment is available contrasted to surface evacuation, that is by ambulance, hospital train or ship.

This contribution to more efficient medical service was in the embryo stage at the beginning of World War II (WW II), however, during the period of 1942 to 1945 it was developed to a high state of efficiency. In spite of the high state of development many authorities on the subject have implied that all the advantages and benefits afforded by air evacuation are not sufficiently appreciated on an army wide basis to realize the maximum benefits therefrom.

b. Echelons of air evacuation. Air evacuation is separated into two broad geographical echelons—that which is performed in the theater of operation and that which is performed in the zone of interior. In the theater this has been subdivided into evacuation performed within the combat zone and evacuation within the communication zone. The zone of interior has likewise been divided into

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that performed between the theater and the zone of interior and that performed within the zone of interior.¹

c. Evacuation and Hospitalization Requirements. The responsibilities for provision of hospitalization and evacuation service as established in FM 100-10 are as follows:

The evacuation and hospitalization system is based on the principle that it is the responsibility of rearward units to relieve forward units of their casualties promptly. This principle extends from the responsibility of the zone of interior to evacuate and hospitalize all long term casualties from the theater of operations to responsibility of the battalion medical section to evacuate casualties from the companies or batteries of the battalion.²

Air evacuation within the combat zone is accomplished by the use of liaison aircraft, helicopters, or light transport planes. The aircraft are operated and maintained by theater airforce units, (i.e. a liaison squadron), but are placed under the control of the army surgeon.³

Where transport aircraft are used for the evacuation of patients from the combat zone to the communication zone, air transportation, and the care of the patients in flight are the responsibility of the theater air force commander.⁴

Air evacuation to the zone of interior rests with the air force as a major responsibility, but the communication zone must arrange for the delivery of patients to the airfield and for their proper care until they are actually placed aboard the aircraft.⁵

Hospitalization is accomplished with installations of increasing size from forward areas to rear that permit rapid sorting, treatment and disposition of patients dependent upon the nature of the casualty. Hospitals used within the theater are classified as mobile and fixed. In general, the hospitals used within the communication zone are of the fixed type while those used within the combat zone are of the mobile type. General hospitals, usually 1000 bed units of the fixed type, are organized and equipped to provide definitive treatment for all types of casualties which occur within the theater. Station hospitals are relatively fixed installations ranging in size from 25 bed units to 900 bed units designed to provide hospitalization for areas where troop population is limited. These hospitals do not normally receive patients

¹ FM 8-35, par 103, p.190

² FM 100-10, par 1005, p. 157

³ Ibid. par 1110, p. 162

⁴ Ibid. par 1012, p. 164

⁵ Ibid. par 1015, p. 166

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from the combat zone. Field hospitals are mobile type hospitals designed and equipped to furnish hospitalization in areas or at installations where it is impractical to establish station hospitals. These hospitals may be used in the combat zone on missions similar to those assigned to evacuation hospitals.

The mobile type hospitals include evacuation, mobile surgical, and convalescent hospitals and are organized and equipped to support specific tactical units by providing hospital service for the sick and wounded personnel of the Army, corps and division, pending their recovery or further evacuation to general hospitals in the communication zone.⁶ In addition to the hospitals already mentioned there is need for medical holding battalions which are units designed to transport and hold patients at air heads, rail heads, and ports while awaiting further evacuation.

The majority of hospitalization service provided in the zone of interior is of the fixed type such as general, regional, station and convalescent hospitals. These hospitals are of a more permanent nature and afford better facilities and treatment. The need for the mobile type hospital in the zone of interior is relatively small and is usually limited to those which are being organized or trained for service in the theater of operations.

In a typical overseas theater evacuation of the sick and wounded is performed by litter bearers, ambulances, liaison aircraft, transport aircraft, helicopter, hospital trains, troopships and hospital ships. The utilization of any combination of these means depends upon the facilities available and the military situation. Evacuation in the combat zone was normally performed by litter bearer to the forward limit of vehicular traffic or airstrips and from there to the evacuation hospitals by motor ambulance or liaison aircraft. The helicopter is ideally suited for this echelon of evacuation. Evacuation to the communication

⁶ FM 100-10, par 1002 a, p. 156

"The evacuation policy announced by theater headquarters determines what classes of casualties are to be treated in the theater of operations and what classes are to be sent to the zone of interior. The established policy has a great influence on the medical activities and requirements of the communication zone and affects particularly the hospitalization projects of this zone as well as that of the zone of interior."⁹

3. Effect of Air Evacuation. In analyzing the effect of air evacuation on the evacuation policy and hospital requirements the medical service has to be divided into that which is performed within the theater and that which is performed in the zone of interior. It is desired to consider the various factors such as transportation, construction effort, and medical manpower as they affect the medical service in the theater and in the zone of interior.

a. The European theater has been selected for the study of the effect of air evacuation on the evacuation policy and hospital requirements in the theater. The average strength of the MTO during the period January 1945 to June 1945 (incl) approximated 2,946,725.¹⁰ The daily admission rate to the MTO averaged 1.3 per 1000 per day for non-battle casualties and 0.47 per day per 1000 for battle casualties.¹¹ Based on the above criteria it could be assumed that the average number of casualties for a one month period would approximate 162,000 non-battle casualties and 11,548 battle casualties. The disposition of the battle casualties based upon experience factors of WW II would be as follows:¹²

- 4% (1662) die after reaching the hospital.
- 15% (6232) recover in 15 days.
- 19% (7894) recover in 30 days.
- 17% (7063) recover in 60 days.
- 11% (4570) recover in 60 to 90 days.
- 20% (8300) recover in 90 days.
- 14% (5820) invalided home.

⁹ Medical Service- Communication Zone, Subject 4300, Adv Sheet, par 8, p. 12

¹⁰ Historical Review, WWII, Append P, p. 58

¹¹ FM 101-10, Chap 5, par 513 e and d, pp. 55-56.

¹² Ibid. par d, p. 56

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While no figures are available to indicate the disposition of non-battle casualties in the ETO such figures are available for the Mediterranean theater and by substitution of these figures for the non-battle casualties in the ETO the expected disposition of the non-battle casualties would be as follows:

0.2% (336) die after reaching hospitals.

4.0% (6720) were evacuated to the ZI.

95.8% (160944) returned to duty within the theater.

Average stay in hospitals for non-battle casualties in the theater of operation — 19 days.

Average stay in hospitals for non-battle casualties in both the ZI and the theater — 25 days.

Assume further that a 15 day evacuation policy was in effect in the combat zone. By referring to the disposition expectancy for battle casualties on the preceding page it will be noted that 814 (33,650) of these battle casualties would require evacuation to hospitals in the communication zone.

Based on the assumption that 2/3 (110,000) of the non-battle casualties will require evacuation from the division or corresponding areas and require hospitalization in the communication zone the magnitude of the hospitalization and evacuation service can be realized. ¹⁴

The theater evacuation policy will have very little effect on the numbers to be evacuated to the communication zone but would have effect on the distance that patients would require evacuation. If the average distance from the evacuation hospitals in the combat zone to the general hospitals in the communication zone approximated 300 miles the requirements for evacuation of the battle casualties would be represented by one of the following means:

	No Bat Cas Per Month	Unit Loads Per Month	Units required Per Month	Hours Per Trip
Hosp Train	33,654	110.2	18.3	120 (1 trip ea 5 day)
C-82 Acft	33,654	960.0	16.0	4.5 (2 trip per day)

13 FM 101-10, Chap 5, par 513 c, p.55

14 Ibid.

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Hospital requirements for the non-battle and the battle casualties for this number of casualties based on Accumulation Tables 1, 2, 3 and 4 at 120 days for the various theater evacuation policies would be as follows:

<u>Evac Policy</u>	<u>No. Fixed Beds</u>	<u>% Decrease</u>	<u>Decrease 120-day</u>
120-day	209300	—	—
90-day	195850	6.5	—
60-day	172970	13.5	16.8
30-day	128967	25.4	38.4

It may be noted from the above that the fixed bed requirements decrease with any decrease in the evacuation policy. The requirements of the 60-day policy call for some 36000 less beds which corresponds to 36 general hospitals. This in turn would reduce the outgoing tonnages by 234,000 measurement tons representing about 24 shiploads of equipment which would not be required in the theater. 15 Also a savings in construction effort of 5,500,000 man hours (1377 four-man days) would be effected. 16 The savings in medical manpower resulting from the utilization of air as the principal means of evacuation would approximate 5% of the medical personnel in the theater. (See par 5)

b. No accurate figures are available which show the medical support provided by the zone of interior for the army forces in the European theater separated from other theaters. However, by using the average STG strength figure and applying the II evacuate factor contained in the accumulation tables 1 to 4, the approximate medical support can be obtained. 17 These figures will be slightly higher than the actual requirements as indicated in accumulation table 5, which is based on an evacuation policy of 120-days.

15 FM 101-10, Chap 5, par 532 e, p. 122

16 Ibid. par 528 b, p. 166

17 FM 101-10, Chap 5, pp. 58-60

II Fixed Requirements for Support of Overseas Theater
Strength-2945725--120 days accumulation

<u>Evac</u> <u>Policy</u>	<u>Fix Bed</u> <u>Requirements</u>	<u>% Increase from</u> <u>Present Policy</u>	<u>% Increase from</u> <u>120-day Policy</u>
120	35600	---	---
90	47300	33	---
60	70900	50	99
30	114700	62	222

It is noted by an examination of the above table of fixed bed requirements that the 90-day policy will increase fixed bed requirements in the II by some 33% over the requirements for the 120-day policy. The 60-day policy will increase the requirements by 50% when compared to the 90-day policy and 99% when compared to the 120-day policy. The extreme is reached with the 30-day policy which would increase the requirements 222% over that required by the 120-day policy.

To obtain some idea of the evacuation requirements, assume the distance casualties were evacuated from the STO to debarkation hospitals in the II to be an average of 3000 miles. The following table shows the requirements for the various means evacuation for each of the various policies.

<u>Evac</u> <u>Pol</u>	<u>Pat</u> <u>Cas</u>	<u>Means Required for Evac to II</u>			
		<u>Hosp Ship</u> <u>Required</u>	<u>Troop Ship</u> <u>Required</u>	<u>C-54 Acft.</u> <u>Required</u>	<u>C-74 Acft.</u> <u>Required</u>
120	5820	15.1	14.5	10.7	3.5
90	14020	36.4	34.9	25.29	8.5
60	18590	48.2	47.5	34.4	11.3
30	25635	66.5	64.0	47.4	15.6

Notes: 1. Hosp ship @ 500 per trip round trip every 39 days or average of 385 patients per month.

2. Troop ship @ 540 patients per trip, round trip every 39 days for average of 400 patients per month.

3. C-54 Airplane @ 36 patients per trip, round trip every 2 days for average of 540 patients per month.

4. C-74 Airplane @ 109 patients per trip, round trip every 2 days for average of 1635 patients per month.

4. Ratio of Fixed Bed Requirements. One of the many problems confronting logistical planners and medical support planners is the

determination of the correct ratio of fixed beds in the zone of interior to the overseas theater. Such requirements are based upon the evacuation policy, daily admission rates, accumulation factor and the dispersion factor.¹⁸ The length of time required for the selection of sites, procurement of construction materials and the actual construction of the hospital facilities, both in the overseas theater and in the zone of interior, makes advance planning vital to a successful hospitalization program. As a guide in determining the effect of air evacuation on the ratio of fixed beds in the theater and in the zone of interior the following table, based on the same assumptions used in paragraph 3, will be used.

Fixed Bed Requirements - Overseas Strength 2,946,725

Over Sea Pol	% in II	Overseas Requirements		II Requirements		Total
		To Beds	% Strength	To Beds	% Strength	
120	14.5	209300	7.0	35600	1.2	244900
90	19.4	195850	6.6	47300	1.6	243150
60	29.2	172972	5.8	70900	2.4	243870
30	47.2	128970	4.3	114700	3.9	243670

The requirements in the II during WW II was based upon 1% of troop strength plus 0.7% for overseas strength.¹⁹ The STO share based upon these percentages and the average troop strength would provide approximately 50,000 beds in the zone of interior. This would represent sufficient beds for either the 120-day policy or the 90-day policy but would not accommodate patients accumulated under the 60-day or 30-day policies. It should be noted that the fixed bed requirements are about the same for all of the policies. As has been pointed out previously, the employment of air evacuation favors the shorter evacuation policies which in turn increases the ratio of fixed bed requirements in the II and decreases the requirements in the theater.

5. Conservation of Medical Manpower. Figures compiled and published in the "Statistical Review, WW II," indicate that the overall requirements for medical personnel to staff hospitals, medical installations and perform the required medical service during the past war reached a peak of 697,541 in October 1944. This shortage in specialists and other medical personnel resulted

¹⁸ FM 100-10, par. 1002

¹⁹ Subject L-4305, Append 1 to advance sheet, p. 14

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to units being shipped overseas short T/O personnel. To alleviate this shortage strict controls were initiated in the United States in the summer of 1944, however, in spite of this strict control the shortage continued until shortly before the end of the war in Europe. 20

The scraping of the barrel so to speak in the last war should be sufficient warning to all concerned of the importance of conserving medical manpower. The extent of any reduction in personnel requirements resulting from the use of air evacuation will be dependant upon many factors such as the tactical situation, evacuation means available, terrain and etc. The inherent difficulties connected with air evacuation such as the weather, adequate landing facilities together with the prerequisite of air superiority precludes the possibility of air evacuation having the capability of performing 100% of the evacuation effort. It will always be necessary to have sufficient means such as ambulances, hospital ships, hospital trains and holding units to accomplish the evacuation mission when any of the above factors limit the air effort. This in turn will restrict the savings effected by use of air evacuation.

To arrive at an approximate figure of the savings in medical manpower that could reasonably be expected from the utilization of air evacuation in the combat zone, let us examine a hypothetical situation utilizing the "Type Field Army (Proposed)," 21 This organization has an authorized strength of 358,975 of which 3% are medical personnel. In furnishing hospitalization and evacuation for a force of this size, the communication zone would contribute the services of approximately 11,000 medical personnel also. The casualties of such a force, based on a theater evacuation policy of 120-days, a daily admission rate of 1 per 1000 per day each for battle and non-battle casualties, and a 15 day evacuation policy for the combat zone, would approximate 21,500 per month. Of this total 4% would be expected to die, 8% will have recovered and returned to duty within the month, and 74% or 15,900 will require evacuation to general hospitals

in the communication zone; Of this

20 Pamphlet, Type Field Army (Proposed)

21 FM 101-10, Chap 5, par 613 (d), p. 56

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latter figure 14% would require evacuation to the ZI for further hospitalization and evacuation within the ZI and possible separation from the service. 22

By an examination of the hospitalization and evacuation effort required for this number of casualties and based on the assumption that these casualties are evacuated over an average distance of 300 miles it can be determined that a savings of 1143 medical personnel and one evacuation hospital could be achieved by making use of air evacuation. This could represent a 5% savings in medical personnel and a 2% savings in evacuation hospitals. While it does not appear feasible to plan on performing all evacuation by air it does appear that in order to effect the maximum savings air evacuation should be used when ever possible.

Another factor contributing indirectly to the conservation of medical manpower by utilizing air evacuation results from the ability of quickly evacuating patients to hospitals where the services of specialists are available. Our Air covered this phase of the conservation of medical manpower as follows: 23

It is quite apparent that there were not enough specialists in the army to bring the highly skilled doctors to the thousands of sick and wounded on the battle field but the chain of evacuation that was perfected to a high point of efficiency in all theaters performed a good job of moving the wounded to the various stations where they received the needed attention.

These factors would apply equally well to the evacuation performed between the Theater and the zone of interior as well as that performed within the zone of interior. The greatest savings in medical personnel would be effected by a reduction in personnel required to operate holding units, hospital trains, hospital ships, and by the conservation of the services of the skilled specialists.

6. Treatment of Patients. Air evacuation offers several

22 FM 101-10, Chap 5, par 613 d (b), p. 56

23 Maj Gen Norman T. Kirk, Surgeon General, "Air Evacuation of the Wounded," Military Review, Vol. XXVI No 10, Jan 1947, p.28

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Distinct advantages to patients thus transported, however, there are also some limitations as to the type of patients that may be safely transported by air. The following extract from instructional material issued at the O & O&F establishes the present thinking related to the type patients that may be evacuated by air: ²⁴

Any patient who may be classified as transportable, may be transported by aircraft provided certain conditions are met. These conditions are (1) limitation of altitude not to exceed 3500 feet, (2) oxygen therapy availability, and (3) trained medical attendants present. The first condition was satisfactorily met in most theaters of operation by judicious choice of evacuation routes. When conditions cannot be satisfied, especially regarding altitude of flight, it is necessary to exclude certain types of casualties. In general, major surgical abdominal cases within seven days after surgery, pneumothorax cases, and markedly severe anemia do not react favorably to altitudes exceeding 3900 feet. However, many patients of this type react unfavorably to any form of transportation.

In aircraft converted for the transportation of casualties, considerable treatment can be administered enroute. It was normal in the past to provide a nurse and at least one medical technician for each airplane that was to be used for evacuation. This team afforded the patients treatment as needed for the readjustment of splints, administration of stimulants, sedatives, plasma, and other medications, arrest of hemorrhage, treatment of shock, and most important of all, administration of oxygen, when indicated. ²⁵

Another very important advantage in connection with the treatment of patients afforded by air evacuation rests in the field of surgery. Gen Kirk has the following to say regarding this phase of medical treatment: ²⁶

Air evacuation of wounded, permitting prompt surgery, along with the administering of penicillin, the sulfas and blood plasma, has been one of the outstanding contributions of this war in the care of the sick and wounded. This speedier link in the chain of evacuation was of far greater importance in the war against Japan, both because of the distances involved and the nature of the terrain over which fighting took place.... Early care is of the greatest importance in both surgery and

²⁴ Subject 4308, "Medical Service in Communication Zone", Appendix 4 to Adv Sheet, par 9, p.26

²⁵ FM 8-35, par 102 f.

²⁶ Maj Gen Kirk, op. cit., pp. 27-29

medicine and it is highly essential that skilled specialists start their work at the earliest possible moment. Army record of saving about 96% of wounded who reach a hospital is largely due to the fact that the skilled surgeons were able to administer the proper care at an early stage in the chain of evacuation. Early attention for those who are sick is also an important factor in the army's disease rate resulting in less than 1 death per 1000 per year... In the case of surgery the time element is always of prime importance. It often means the difference between the loss of an arm or leg or even can be the matter of life itself.

Capt Grace H. Stakeman, ANC, adds the following thoughts in regard to the medical treatment of patients: 27

Experience in WW I indicated that speed in evacuation and early treatment of wounds would lead to a lower mortality and morbidity rate. This was conclusively proved during the last war. Early in 1942 air evacuation of the sick and wounded became a military necessity for us, and long before VJ day it was considered the method of choice.....

Prior to the war, medical authorities here and abroad feared that patients with many different types of medical or surgical illness would be endangered by flight. Experiences of the past four years has not borne this out. Because of the necessity for experienced medical attendance in flight, nurses and enlisted men received special training for this work. Medical personnel who have received adequate instruction in the care of patients while in flight have enabled the AAF to fly patients with almost any kind of disorder....In many discussions with ground force surgeons, surgeons who operated near the front lines, we agreed that it was probably better to do the surgery at the advanced hospitals, and then evacuate the patients back to the general hospitals for convalescence, in view of the fact that if these patients were operated upon under the old system at these advanced hospitals, they would have to remain there for a period of several days because transportation by ground was so difficult and torturous and occupied a much longer period of time.

In other theaters, front line portable hospitals were used corresponding to our evacuation hospitals in the ETO, and the surgeons at these hospitals told me they could do much better surgery and much more extensive surgery in the front line, knowing that the patients were going to be returned to a general hospital in very excellent condition....

The factor of morale of the combat troops is also favorably influenced by air evacuation. The knowledge that they can be evacuated by airplane, if wounded, to hospitals where the best in medical treatment is available has a marked influence on troop morale. Gen Kirk covers this aspect of air evacuation with the following remarks: 28

There is one phase of this air evacuation subject that I have not covered. It is of an intangible nature. I can give no figures. Yet it is recognized by army authorities as a very important by-product of this system of transporting the disabled by air. That is the matter of morale. Unless you have

28 Capt Grace H. Stakeman, ANC, "Medical Care of Casualties in Long Distance Evacuation (Air)," The Journal of Aviation Medicine, Vol 18, No. 2, April 1947, p.192.

28 Maj Gen Kirk, op. cit. p. 33

been thousands of miles away from home under circumstances such as confront troops in battle you will never know how comforting the thought is that if you should be wounded air-transport could take you home in a matter of few days. Also important to a man fighting in a jungle or isolated area is the thought that if an emergency develops, army planes can pick him up and get him the best possible medical care. It is realized that morale is a big factor in the winning of battle and it has been proved that this air evacuation system played an important part in morale.

7. Replacement Requirements. Prior to WW II a replacement system worthy of the name had not been developed. This matter had received considerable study before and during the early stages of WW II and as a result of these studies, the War Department directed in May 1944, the establishment of centralized and uniform replacement systems in each of the theaters, and announced the basic principles which should govern the operation of this system.²⁹

The part of this system that is of concern during this study is that which deals with the hospital returnee. One of the main principles regarding evacuation is that a patient is evacuated no further to the rear than his physical condition requires or the military situation dictates. Strict adherence to this principle will restrict some of the benefits and advantages afforded by air evacuation. There should be very little argument over the fact that a patient will receive much better treatment in hospitals deep in the communication zone or in the zone of interior than that afforded him in evacuation hospitals in the army area where the situation is not so favorable.

Under the present replacement system it has been estimated that the hospital returnee, who has been determined fit for combat duty by the medical personnel assigned to the replacement depot in the communication zone charged with receiving and examining returnees, will spend 6 to 7 days in the replacement stream before reaching his old outfit.³⁰ In a situation similar to that encountered in WW II, this time spent in the replacement stream would increase to

²⁹ G-1 Manual, Chap 3, par 304-305

³⁰ Subject 1001, "Replacement Support, Communication Zone," advance Sheet, par 2 c, p.2

approximately 100 days if the hospitalization occurred in the zone of interior.³¹ The loss of manpower represented by the amount of time consumed in returning hospital returnees to the combat zone is excessive and it is not conducive to a shorter evacuation policy. It would appear that this time lag could be reduced by streamlining the replacement system in so far as it effects hospital returnees which would be much more favorable to a shorter evacuation policy.

To carry this a bit further let us examine some experience figures of WW II.³² During October of 1944 the strength in the ATO was 2,026,350, the annual admission rate during this month was 693 per 1000.³³ At this rate a total of 117,000 patients were admitted to the hospital during October. Of this number approximately 60% or 70,000 of these patients were evacuated to the communication zone. Approximately 25% or 17,000 would have been evacuated to the zone of interior under an evacuation policy of 120-days, some to be invalided home others to be returned to duty in the theater. This represents the loss of strength of one infantry division for over three months, which appears quite excessive. While it is within the capability of air evacuation and a short evacuation policy to perform the majority of hospitalization in the zone of interior, such a policy will definitely increase the replacement requirements. However, if the time spent in the replacement stream could be materially reduced then the loss of man hours would not be as excessive and consequently less replacements would be required. Air evacuation would reduce these requirements somewhat by providing speedier transportation to the zone of interior where hospitalization and treatment could be started earlier.

7. Future Warfare. Air evacuation will undoubtedly play an important and ever increasing role in future warfare. Any study concerning any phase of future warfare must include the effects of such weapons and tactics as envisaged in atomic warfare, biological warfare and chemical warfare. When, under what conditions and how these weapons might be employed against our armed forces or civilian

³¹ Subject 1092, "Personnel Distribution and Flow," Chart 1, Sec III

³² Statistical Review, WW II, Append P. p. 198

³³ Ibid. Append R, p. 230

population is a matter of conjecture. One thing that appears relatively certain at this time is that the implementation of this type of warfare will result, initially at least, in a tremendous number of casualties which in turn will result in overloading normal evacuation and hospital facilities. Air evacuation with its greater flexibility, mobility and speed would offer the only practical solution to such a problem.

Any war of the future appears certain to be one that will be fought on a global scale. This brings up the question of effect that the various theaters of operation might have on employment of air evacuation. A brief study of the history of the employment of air evacuation in the last war will indicate that air evacuation performed admirably in all theaters. Even more noteworthy was the demonstrated ability to perform its mission under the most adverse conditions, especially in the jungle areas of the Southwest Pacific and in the China-India-Burma Theater where other methods were extremely costly in time and effort or failed completely.

5. Adequacy of Equipment. The present aircraft used in air evacuation, although not primarily designed for this purpose, are considered adequate with respect to all echelons except that which is performed in the combat zone. It is believed that there is a definite need for the development of aircraft more suitable for use in evacuating patients from forward areas to army evacuation hospitals. The development of helicopter is progressing rapidly and should contribute materially to this echelon of evacuation in the future. The L-5 is handicapped by its limited carrying capacity (1 litter patient), the L-13 although slightly larger carries only one patient, and the L-15 is designed primarily for observation and has no provisions for litter patients. The helicopter with increased carrying capacity would be the best answer to this problem. Another thought is the development of a small airplane with similar flight characteristics to the L-5 but with the capability of carrying two or three litter patients.

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Annex 2. Comparison of Means of Evacuation.

1. Performance of the various means of evacuation may be compared by the following methods:

a. Time element of evacuation as established in Draft FM 101-10, Chap 5, par 516, p. 61.

"Ambulance, motor, during combat, in division area:
5 miles and return in one hour.

Aircraft:

Liaison airplane (L-5)--50 miles one way in one hour.
Cargo airplane (C-47)--100 miles one way in one hour.

b. In a pamphlet, "Patient Air Evacuation," published by the Office of the Surgeon, Air Transport Command, the claim is made that 14 C-54 airplanes per day will evacuate 6 times the number of patients that a hospital ship can with a savings of 34% in medical personnel and at the same time still carry more than 450 tons of high priority supplies back to the combat area on return trips.

c. The average performance capabilities of the various means of evacuation represented in units of litter patients/miles per hour with each "Unit" represented as 1000 patient/miles.

Type	Capacity	MPH	Units
L-5 Airplane	1	90	0.09
R-4 Helicopter		80	0.16
C-47 Airplane	24	145	3.48
C-46 "	24	165	3.96
C-82 "	34	165	5.61
C-54 "	36	200	7.20
C-97 "	83	217	18.01
C-74 "	109	211	22.99
Hosp Ship	500	20	5.00
Hosp Train	300	10	3.00
Ambulance: 3/4 ton	4	15	0.06

R E S T R I C T E D

2. Comparison of the efficiency with which an L-5 airplane, R-4 helicopter and a 3/4 ton ambulance can perform an evacuation mission of moving 20 litter patients a distance of 20 miles.

<u>Type</u>	<u>No.* Patients</u>	<u>No. Trips</u>	<u>Total Miles</u>	<u>MPH*</u>	<u>Total Time</u>	<u>Gal Fuel</u>	<u>Units</u>
L-5	1	20	800	50	20:00	200	0.002
R-4	2	10	400	50	10:00	150	0.004
3/4 ton Amb	4	5	200	10	20:00	44	0.002

* Draft FM 101-10, par 515

** Ibid. par 516

3. Comparison of the efficiency with which transport type aircraft and a hospital train perform an evacuation mission of moving 300 patients a distance of 100 miles.

<u>Type</u>	<u>No. Patients</u>	<u>No. Trips</u>	<u>Total Miles</u>	<u>MPH</u>	<u>Total Time</u>	<u>Gal.* Fuel</u>	<u>Units</u>
C-47	24	12.5	2500	145	23:30	2140	1.28
C-46	24	12.5	2500	165	22:25	3800	1.34
C-82	34	8.8	1764	165	15:05	2675	1.92
Hosp Train	300	1.0	200	10	22:00	2100	1.36

* Pamphlet, "Cargo Aircraft" Chart on page 26.

Note: 15 minutes have been added to each trip for loading, unloading and refueling.

2 hours added to train time for loading and unloading.

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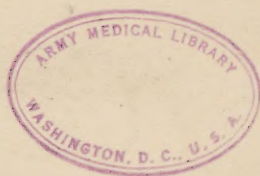
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